LOTUS ENGINEERING

ACTIVE TECHNOLOGY REPORT

TRACK TENSIONING PROGRAMME FOR TACOM ON THE ACTIVE SUSPENSION SCORPION (P3) TANK

Report Number - 2809/94

22nd June 1994

The Power of Innovation

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REPORT NO. 2809/94 - Final Report

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ACTIVE TECHNOLOGY REPORT

TRACK TENSIONING PROGRAMME FOR TACOM ON THE ACTIVE SUSPENSION SCORPION (P3) TANK

Summary

This report is in two sections and covers the two outstanding contracts with TACOM with regard to hydraulic system improvement and the implementation and testing of Active track tensioning on the Active Suspension Scorpion (P3) tank.

Section 1 (contract number DAJA45-93-M-0421) covers the specification of an improved control valve plus the design, manufacture and installation of new valve manifolds. The contract also covers the hydraulic commissioning of the vehicle up to the 3rd September 1993. This work was completed on schedule and was necessary in order to complete the main programme described in Section 2.

Section 2 (contract number DAJA45-92-C-0001) forms the final (eighth) report under this contract number for the implementation and testing of Active track tensioners.

Active track tensioning, as has been shown by DRA data (taken at the tank trials in November 1993), offers ride performance improvements over an uprated passive vehicle and also over the Active suspension vehicle with fixed tensioners. However, it is believed that software corrections made after the trials and the implementation of alternative algorithm ideas, could further improve the vehicle ride performance.

Much improved system reliability, due to the hydraulic work carried out prior to the trials, has been a cornerstone to the vehicle performance and ride data collection.

Contents

1. Vehicle Servicing Contract DAJA45-93-M-0421

1.1 Introduction

Contract DAJA45-93-M-0421 was awarded by TACOM to Lotus for the improvement of the suspension actuator manifolds fitted to the Scorpion P3 vehicle. This followed a period of high attrition for servovalves combined with the general level of difficulty in servicing the valves due to the design of the manifolds.

1.2 Contract Objectives (as Defined Within the Contract)

- The design and specification of a new valve assembly for the Scorpion test vehicle's Active suspension units, followed by installation and commissioning of the new units.

- A new manifold will be designed to accommodate both the current power valve and an externally mounted bypass valve. The design will accommodate the current interface connections with the existing hoses and electrical connections and will form a direct replacement for the existing units.

- The new components will be installed in the vehicle and basic operational tests will be conducted, i.e. electrical continuity and hydraulic pressure tests.

- Using the existing energy saving suspension system software, the performance of the new installation will be tested and verified and any initial problems rectified.

1.3 Action Taken

A manifold was designed to mount both the power and bypass valves at each actuator. During the design process a three dimensional CAD model was created to ensure ports and drillings did not clash. The internal design also ensured that drillings were as direct as possible and were of maximum diameter.

Four manifolds were machined and five bypass valves procured. The manifolds were mounted in the vehicle to give best possible access to fittings and to provide good flow paths. All hydraulic lines on the vehicle were flushed through the manifolds and the system filter replaced. Hydraulic connections were pressure tested and valves were cycled to ensure that they were fully operational and had correct polarity.

During this period it was found that the relief valves for the suspension actuators had been connected to the incorrect side of each actuator. This had led to the failure of valves due to overpressurising and was corrected.

All work was completed successfully prior to the vehicle trials described in Section 2.

2. Track Tensioning Contract (DAJA45-92-C-0001)

2.1 Introduction

This section of the report describes the tuning and testing of the Scorpion P3 tank fitted with Active suspension and Active track tensioners. The testing took place between 1st and 12th November 1993 at DRA's Barnsfield Heath test site located at Hurn, Dorset, England. The report format is a chronological work log to enable easier correlation between the DRA data runs and the parameter sets described in Appendix 4. In addition to the trials log is an explanation of control software changes that have taken place; firstly, prior to the trials and during the commissioning phase of the vehicle in September/October 1993 (Appendix 1); secondly, as a direct result of running the vehicle at the trials (Appendix 2); and finally, as a result of writing the strategy book - requiring detailed inspection of the software (Appendix 3).

2.2 Trial Objectives

The aims of the trials at Hurn were to ensure that the Active suspension and track tensioning systems were operating as designed. DRA were to collect data to determine the relative performance between passive and Active track tensioners. Analysis by DRA of the data following the trials would then provide the results.

2.3 Trial Procedure

Data collection runs were made in both directions of the random course at each speed increment, starting at 5 kph and increasing in 3 kph steps until it was jointly decided that the inputs to the vehicle were moderately severe. This was carried out with the vehicle in different system configurations. Higher speed runs were conducted at a later stage once all low speed data had been collected. This was to ensure maximum survivability of the tank.

The intended programme of data runs was to start with baseline Active suspension parameters with fixed track tension. This was followed by Active suspension with variable modal damping implemented (still with fixed track tension). Finally, data was collected with Active track tensioning introduced.

Active suspension system parameters were to be initially as setting "E" which DRA stated had given the best ride performance in previous trials. The key parameters that formed this setting were inserted in the initial parameter set, the remainder being either "historically" fixed or modified from previous numbers to cater for recent changes in the control software. This formed the baseline condition for testing.

Data was acquired through the Active controller and PC on occasions for diagnostic purposes.

2.4 Trial Worklog

Monday 1st November

The tank arrived at Hurn. The Active tensioners were depressurised, two links removed from each track and the Active tensioners were re-charged to 100 bar.

Tuesday 2nd November

In the morning the operation of system was briefly checked. The initial parameter set was downloaded and saved to the file 2-1.PAR. The parameters included -3000 in Preq (pitch requirement - nose upwards) and fixed gain bypass valve linearisation (GnB) function. The tensioners at this ride height were locked off after the left and right hand tensioner loads (FTenL and FTenR) were set by adjusting left and right hand required tensioner displacement (XreqTL and XreqTR) to approximately -250 counts each. This equates to approximately 8.6 kN with the load cell scalings of 0.029 counts/N. The vehicle ride height was checked by DRA with zero Preq which gave front = 883 mm, rear = 890 mm, measuring from the underside of the track shield to ground.

On the random course the 5 kph runs were made followed by one run of 8 kph. It was observed that there was little bump travel at the rear actuators which was thought to be detrimental to the ride.

Wednesday 3rd November

The tensioners were set up again to have approximately -250 counts of load at a different ride height set-up of Preq = -2000 and Hreq (heave requirement) = -1000. This would have actuator stroke benefits at the rear but still keep the nose of the vehicle raised to avoid sprocket impacts. Parameters were saved as 3-1.PAR.

Much vibration was noticed from the interior of the vehicle when the engine was idling and the system pressured, and whilst this was being investigated it was noticed that the RHR suspension power valve had a bulging torque motor cap. This is one sign of an internal failure of the valve. The valve was removed and replaced by a spare. On returning the faulty valve to Moog, they informed us that the valve was in perfect working order but had previously failed and been reassembled with the same distorted torque motor cover.

Rain delayed proceedings but a repeat of the previous day's 5 kph runs in both directions of the random course was made.

Thursday 4th November

It was decided again to modify the ride height parameters with the rear again lifted a little to increase bump travel (Hreq = -2000, Preq = -1000). Track tension, through the use of XreqTL and XreqTR, was set as before. These parameters were saved as 4-1.PAR.

One complete set of (low speed) data was taken, i.e. 5, 8, 11 and 14 kph with fixed tensioners and constant modal damping. After these data runs, a check was made on the tightness of the power and bypass valve securing bolts. These had worked their way loose due to thermal effects and were re-tightened.

The Active RPM signal failed during this data set and towards the end, the dump solenoid opened several times whilst the tank was stationary. This may have been due to temporary drops in supply voltage to the solenoid. The fault occurred once or twice more during the trial period but not whilst the vehicle was moving and hence was not a factor during the data runs and ride evaluation.

Bdrycf (the boundary value for the software bumpstop for front actuators in compression - the parameter reflects the displacement at which the bumpstop starts taking effect in units of 8 times actuator displacement) was moved from 0 to 5000 to allow the variable damping space to work. A complete low speed (5 to 14 kph) set of data runs was carried out with variable modal damping enabled. This set was with power valve only operation on the LHR after the bypass valve's response became "sticky" (i.e. probably contaminated).

By the last 14 kph run it was apparent that the vehicle was operating asymmetrically left to right and the ride quality was visibly bad. Upon investigation the tensions in the tracks had drifted, the left hand tension greater than the right hand. The reason for this was probably due to a marginally incorrect bias on one of the tensioners. [As fluid and valve temperatures change, so do the flow characteristics of the valve and the null position may shift by a few counts. The tensioners during the trials were run with fixed bias values].

Friday 5th November

The RHF power valve was replaced as a precautionary measure because the mounting lugs which are part of the torque motor cap had become severely distorted due to repeated high bolt torque.

The LHR bypass valve was removed and replaced by a spare, whose bias value (B3biasm) was determined at +50 counts by a manual bias evaluation.

The RPM signal was fixed and was found to be due to a bad Lemo connection at the junction box.

The LHR actuator also had a squeak from the rear mounting bush, which was improved by lubrication.

The tensioners were set and locked for another run with variable damping operating. XreqTL and XreqTR were adjusted until FTenL and FTenR were both approximately -250 counts and parameters were saved as 5-2.PAR. A complete low speed data set was taken up to 14 kph with the system appearing to operate symmetrically and consistently. This was a repeat of the previous day's data with fixed tensioners and variable modal damping.

Monday 8th November

The engine had been removed on the Saturday to correct a leak in one of the gearbox to oil cooler hoses and to repair a broken alternator mounting. By the end of Monday the vehicle was running again.

Tuesday 9th November

The tensioner fluid charges were checked, the right hand tensioner being down to 80 bar. It was thought that this may be due to gas pressure leakage, so the fluid was allowed to depressurise, and the gas spring pressure was checked at 30 bar (i.e. no change). The tensioner fluid was then charged to 100 bar.

At the random waves 2 complete runs of low speed (5, 8, 11 and 14 kph) data were collected. Initially, this was with Active track tensioning and fixed modal damping (9-2.PAR) followed by Active tensioning with variable modal damping (9-3.PAR).

A valve was heard to be "singing" intermittently towards the end of these data runs. This occurs when the flexure tube within the valve oscillates. It was thought to be the left hand tensioner valve (located on the right hand side of the vehicle) and it was replaced.

Because of the ease with which the vehicle had managed the random course at 14 kph, it was decided to conduct 17 kph tests with each of the four conditions, i.e. track tensioning fixed and Active with modal damping fixed and variable.

It was noticed during these runs that the pitch control performance of the vehicle was improved with Active tensioning implemented and the front sprocket did not impact the test surface at points on the course where it had done with locked track tensioners.

It was felt that additional parameter tuning would be beneficial before testing the vehicle at higher speeds.

Wednesday 10th November

Wednesday morning was devoted to tuning the Active system without DRA data collection, with the aim of defining a parameter set that would enable the tank to traverse the random wave course at 20 kph (or faster). Because it had been observed that at 17 kph with a "non-optimised" set-up the front sprocket could ground, initial parameter tuning and evaluation took place at 14 kph.

Run 1: Parameters as optimised the previous day with variable modal damping, Active track tensioning with the tensioner forces set at approximately -250 counts.

Run 2: Track tension reduced such that tensioner forces were -190 counts statically. This did little to improve the vehicle visually, but the driver believed it to give a softer ride.

Run 3: As above but Hreq lowered to -1500 with Bdrycf reduced from 5000 to 0. The change in ride height caused the front sprocket to be closer to grounding but the bumpstop boundary change was believed to be beneficial.

Run 4: Hreq returned to -2000 and the left and right hand tensioner gains (GTenL and GTenR) raised to 15,000. This proved to be a good run but appeared a little asymmetric towards the end. The fluid pressures in the tensioners were checked (LHS - 112 bar, RHS - 95 bar). The left hand tensioner pressure was relieved to about 103 bar and the right hand tensioner was pumped up to this amount.

Run 5: For the purpose of further protecting the front sprocket, OPFcf (output factor, compression, front) was lowered from 24,000 to 22,000 and the run was made at 20 kph. On the return journey (which every time appeared more severe than the forwards journey) the front sprocket crashed in a couple of places.

Run 6: Variable modal damping parameters modified. Pfmn (filtered pitch force, lower threshold) was lowered from 6000 to 5000, IPCcMn (minimum inverse pitch damping) was lowered from 2000 to 1000 and Pfmx (filtered pitch force, upper threshold) was lowered from 10,000 to 9000 (parameters saved as 10-6.PAR). The effect of these changes was to enable adaptive damping in pitch at lower pitch forces and increase the maximum pitch damping. The sprocket did not crash on either leg of the course at 20 kph and these were defined as the "optimised" set.

With this parameter set DRA collected a full data set over 5, 8, 11, 14, 17 and 20 kph, the only modifications made being with XreqTL and XreqTR between runs to ensure that static tensioner forces did not drift. There was confidence that these parameters could be used at 23 kph, but running the vehicle at that speed would be jointly decided on Thursday (once the vehicle had been demonstrated to Bruce Maclaurin of the DRA at lower speeds). With this data set DRA then had enough random course data to be sufficient for ride performance analysis between the different vehicle conditions. Further data was now only required from the sine wave courses.

At one or two points along the course, particularly at the higher speeds, the front wheels seemed to be held up immediately after the front of the vehicle had traversed a crest (i.e. when it was expected that the actuators would be extending). The reason for this behaviour was not known.

A valve was heard to be "singing" again which was thought to be a tensioner valve but due to its intermittent nature and the time required to get inside the tank once it had stopped at the end of a test, it was impossible to identify which valve was the culprit.

Thursday 11th November

It was decided to do some vehicle checks before demonstrating the vehicle.

The tensioner loads were set to approximately -200 counts with the vehicle at its running height (including Hreq = -2000 and Preq = -1000) and the ride height was checked.

Ride height (Hreq and Preq = 0; LHF,RHF,LHR,RHR): 507,510,510,517

Ride height (Hreq = -2000, Preq = -1000; LHF,RHF,LHR,RHR): 565,567,527,535

These ride heights were measured from the underside of the track shield to the wheel centres - this being the standard method at Lotus of evaluating suspension location.

The pump attenuator was checked for charge. It was possible that some of the pipe vibration that may have contributed to "singing" valves, was due to incorrect charge in the pump attenuator and hence undamped pressure pulses from the pump. Fluid emerged from the charging valve and hence the bladder had a leak. As the attenuator is located before the system filter in the pressure line, any system contamination due to the split attenuator bladder had been contained. It was therefore decided to continue with testing to the point at which DRA had enough data from the trials.

At each speed the tank was driven over the 4.5m and 7m sine waves. The speed of these runs was successively increased by 3 kph and DRA took data from all runs. Runs successfully completed were 5, 8, 11, 14, 17, 20, 23, 26, 29, 32 and 35 kph by which time the tank was tending to jump from one crest to the next and using full suspension travel. Pitch control of the vehicle was good throughout and it was possible to "drive through" the pitch resonance [ref. 1 (page 26)] which occurred between 20 and 23 kph.

DRA stated that they had as much data as they required and it was decided that the health of the system should then take priority over further demonstrations. The system accumulator charges were checked (all but the LHF due to it being inaccessible) and were still at 70 bar. (A new attenuator bladder has since been fitted to the vehicle).

- End of Trials -

2.5 Discussion

The DRA results [ref. 1 (pages 14 and 16)] show that the best ride across the random course was given by Active suspension without variable modal damping and with Active track tensioning enabled.

The use of Active tensioners gives benefits both in improving the ride performance and reducing the chance of sprocket grounding [ref. 1 (pages 15 and 17)]. The latter effect implies improved pitch control of the vehicle compared with fixed tensioners although this is only just apparent at high vehicle speeds from DRA's rms pitch angle measurements [ref. 1 (page 24)].

From analysis of Lotus data taken during the trials, it has been discovered that the tensioners, when assumed to be locked still, in fact moved and the displacements seen are significant. Figure 1 shows left hand tensioner displacement on the random course at 17 kph with "fixed" tensioners. Figure 2 shows the same channel and conditions with Active track tensioning. [The scaling of the graph's y-axis is approximately 20 counts/mm].

The current means of fixing the tensioners is by way of a manual valve that isolates the third volume of the tensioner from the gas spring. The other two volumes are connected, as before, to the servovalve output ports. The design assumption was that by closing the manual valve the third volume would totally lock the actuator. For this reason, the valve drive signal was not inhibited during the fixed tensioner runs. Pressure transducer data (this sensor is gas spring side of the locking valve) shows that the gas spring is isolated from the actuator. It can be seen in Figures 3 and 4 that there is a relationship between valve drive signal and tensioner displacement; the implication being that there remained compliance in the third volume such as trapped gas. Future trials where fixed tension is required should be conducted with the tensioner servovalves set to null (by setting GTenL and GTenR to zero) which would then lock all three volumes.

It has been demonstrated that Active track tensioning as currently implemented does improve ride over fixed (although as seen, not totally fixed) tensioners. The question to be answered is, "How does Active track tensioning in its current form give ride improvement ?"

It was anticipated that the Active track tensioners would give a more constant track force than the passive equivalent. DRA data, manipulated to show standard deviation of track tensioner load [ref. 1 (page 22)], shows this not to be the case. Lotus data taken at the time also suggests that tensioner load is not being smoothened by the current use of Active control.

It was thought that Active tensioning would allow greater articulation of the suspension actuators but from the trials data this appears not to be the case.

The control strategy for track tensioning currently attempts to ensure a constant track perimeter based on the signals from suspension displacement transducers. If an actuator attempts to extend, it has to work against the track tension. The tensioner will only contract and relieve the tension once the displacement has been achieved. In contraction, there would

appear to be no problem in actuator motion. However, the tensioner will "follow" the motions of the end wheel stations and extend to cater for the expected reduced tension. This will work against the next "extend" request to the suspension actuator. Due to this, the average amount of time that the suspension actuators work against the track will be increased and the consequent variation actuator travel reduced. This may be the reason for the reduction in wheel station 1 actuator stroke between the baseline condition and Active tensioners [ref. 1 (page 21)]. It is seen that when variable modal damping is introduced, wheel travel again is increased. This is thought due to the "slackening" of the bumpstop boundary parameter (Bdrycf) made at the same time (to give variable damping "space to work").

The reason for improved ride, as DRA suggest [ref. 1 (page 7)], may be due to the pitch centre moving forward (in response to lower actuator displacements at the front). Further investigation into the reasons for improved ride should be pursued.

An alternative approach to the current tensioner strategy could be to derive the perimeter estimation from desired suspension actuator position (modelled displacement plus dynamic required displacement) rather than actual displacement. This could aid suspension movement (in droop) and reduce suspension actuator displacement error. This may enable displacement error feedback gain (Gdf and Gdr) to be reduced for the purpose of improving ride comfort.

Force control strategies are an option for the track tensioners. There is little doubt that this would reduce tensioner load fluctuations but effective sprocket torque resisting software would need to be devised and written such that it would inhibit the track "jumping" on the sprocket during neutral or low speed turns. A speed dependant force gain may be the solution to this.

Ride performance with variable modal damping enabled [ref. 1 (pages 14 and 16)] is seen to be worse than with it disabled. The variable damping routine as currently written increases damping (in heave and/or pitch modes) based upon the level of (filtered) force being measured. At all vehicle speeds the "variable damping only" parameter set, is seen to give worse ride performance than all other Active conditions. Even at low vehicle speeds it would appear that modal damping was being increased by the routine with consequently worse ride. Increased damping at all speeds will cause higher vehicle body accelerations except in the case where sprocket grounding is avoided.

Further tuning of the variable damping parameters may give a better ride performance by making the nominal level of pitch and heave damping lower. However, the process of tuning is difficult as quantified changes in ride performance are not available until long after the runs. A useful improvement to the trials method to aid tuning would be an immediate (within two minutes, maximum) ride discomfort value output. A more "intelligent" adaptive algorithm is possibly required. This could increase damping level sharply due to perhaps a high front hub acceleration and decay down to a softer damping level at a slower rate.

The "optimised" parameter set, 10-6.PAR, (which was set up for traversing the random course as fast as possible - and not for general ride improvement) included both variable damping and Active track tensioning but gave worse ride performance than when variable damping was not used. Only at the fastest vehicle speeds do the optimised parameters appear to give benefit.

Software Errors

In compiling the strategy book for the software documentation, detailed analysis of the algorithms was required. An error in the implementation of parallel spring terms (explained in Appendix 3) was found and is believed to have had an effect on vehicle performance.

An incorrect spring compensation will have led to an incorrect actuator response to road inputs. This would have been a problem during pitch motions and single wheel inputs, where there was a difference between the estimated positions of the second and fourth wheel stations (XC2 and XC4 respectively) of each side. If, for instance, the scenario is taken of the rear of the vehicle riding over a bump giving the calculated position of XC4 as into compression (positive counts). F1sp (left hand front parallel spring correction term), with the trial's software, would have been calculated as being too large a positive number to correctly compensate for the actual front load cell signal change. In the modal force calculations (ignoring local force input) this would have resulted in an overall negative velocity demand for that corner (DX1mod), extending the actuator. Conversely, if the rear of the vehicle was in a dip (again ignoring local force input), the front actuator would compress. It is this latter case that may have been causing the front actuators to be held up as described in the worklog. These reactions to inputs suggest that on average a higher level of heave acceleration will be imparted to the vehicle body, worsening the ride. (With the corrected code, the torsion bar parallel spring terms should be re-evaluated and checked by moving the vehicle in heave and pitch and observing that the changes in spring force correction (F1sp...F4sp) match the change in the load cell readings (F1...F4)).

The performance of the vehicle over the sinewaves was good and it did not suffer the severe pitching motions experienced in earlier trials.

Due to the hydraulic reworking of the tank in the spring and summer of 1993, the reliability of the vehicle has been much improved. During the trials, there was only one valve replacement that could be attributed to the contamination of the system. The "singing" valves, it is believed were caused by the pressure pulses in the supply line as a result of the damaged attenuator bladder.

2.6 Conclusions

1. Active track tensioning when implemented on the Active Suspension Scorpion P3 has shown an improvement in ride performance over the passive suspension vehicle and also over the Active suspension vehicle with fixed tensioners.

2. Hydraulic system reliability, due to improved design and system cleanliness has been greatly improved.

3. The correction of control software errors found since the trials, it is felt, would further improve the Active suspension ride performance.

2.7 Recommendations

1. Trials data shows that some of the vehicle parameters influenced by Active track tensioning (standard deviation of tensioner loads, suspension articulation) have not changed in the manner originally expected - and yet ride quality has been improved. Investigation is recommended to fully understand the reasons for these effects.

2. It is believed that due to recent control algorithm modifications, improvements in ride performance can be made from the Active suspension. The ride of the vehicle could also benefit from modifying the track perimeter estimation to take account of desired, rather than actual, suspension displacement. These and other control algorithms (alternative methods of variable modal damping, force control of tensioners) should be investigated in the light of much improved hydraulic system reliability.

2.8 References

1. D.F. Turner and E.B. Maclaurin; Results of Ride Performance Trials of the Active Suspension Scorpion fitted with Actively Controlled Tensioners. Report number DRA/FVS/FV&S4/WP9424/1.0.

3. Figures

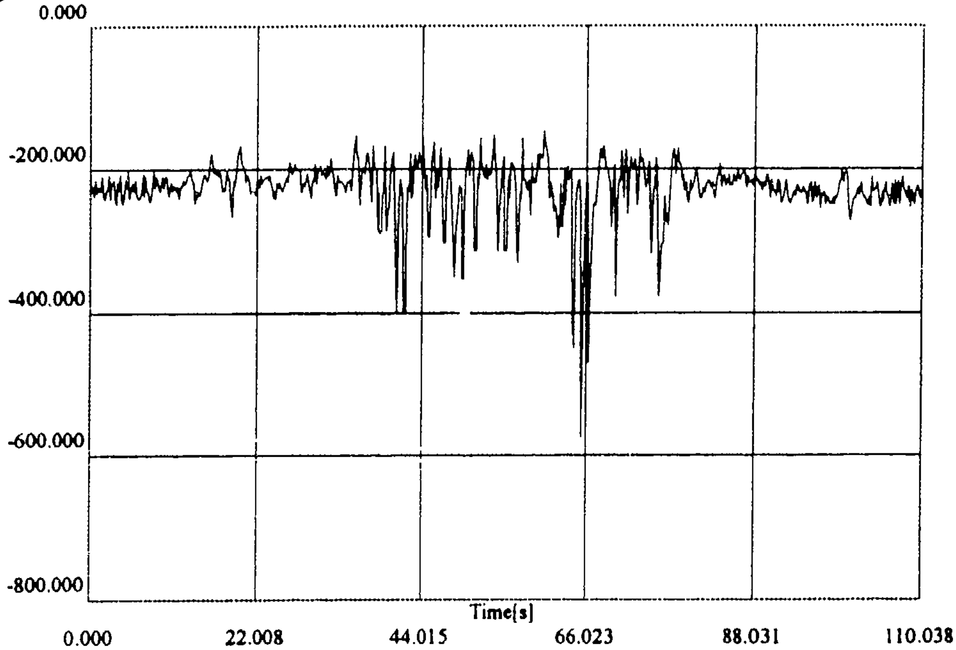

Figure 1: Left Hand Tensioner Displacement - Random Course at 17 kph (Fixed Tensioners)

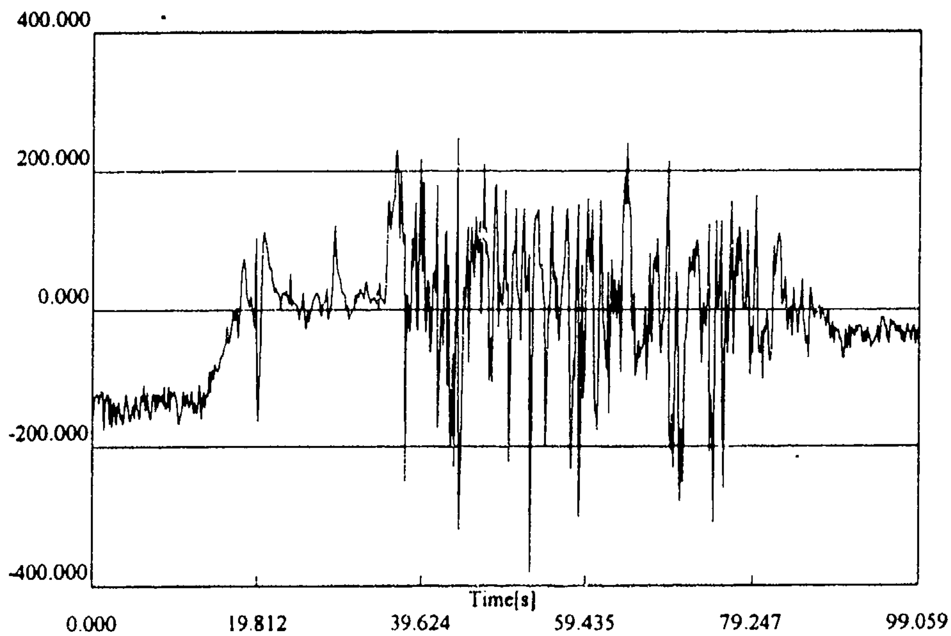

Figure 2: Left Hand Tensioner Displacement - Random Course at 17 kph (Active Tensioners)

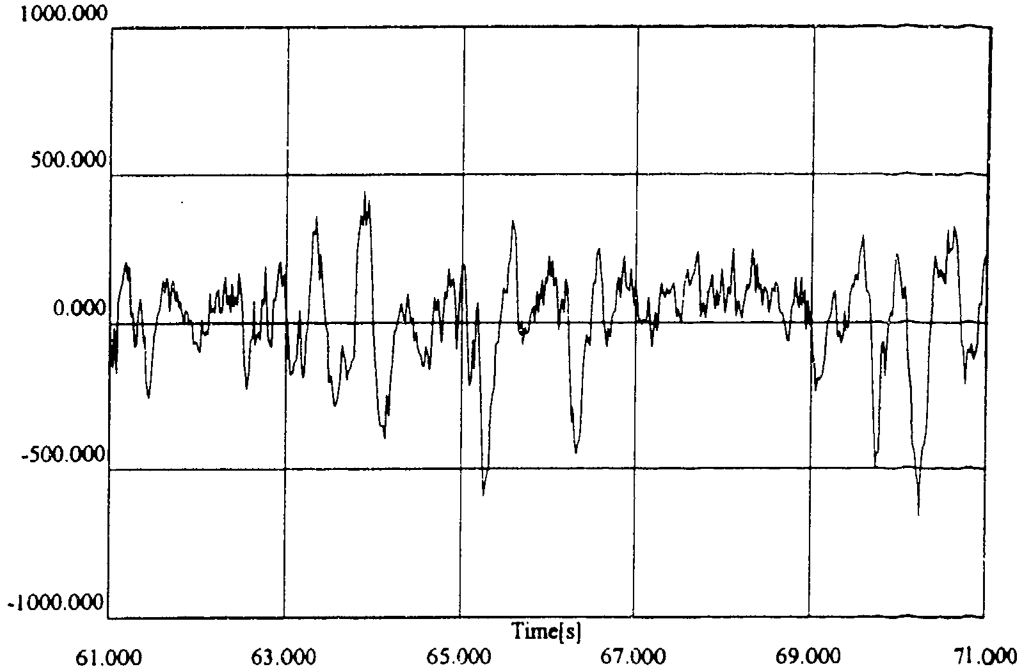

Figure 3: Left Hand Tensioner Valve Drive - Random Course at 17 kph (Fixed Tensioners)

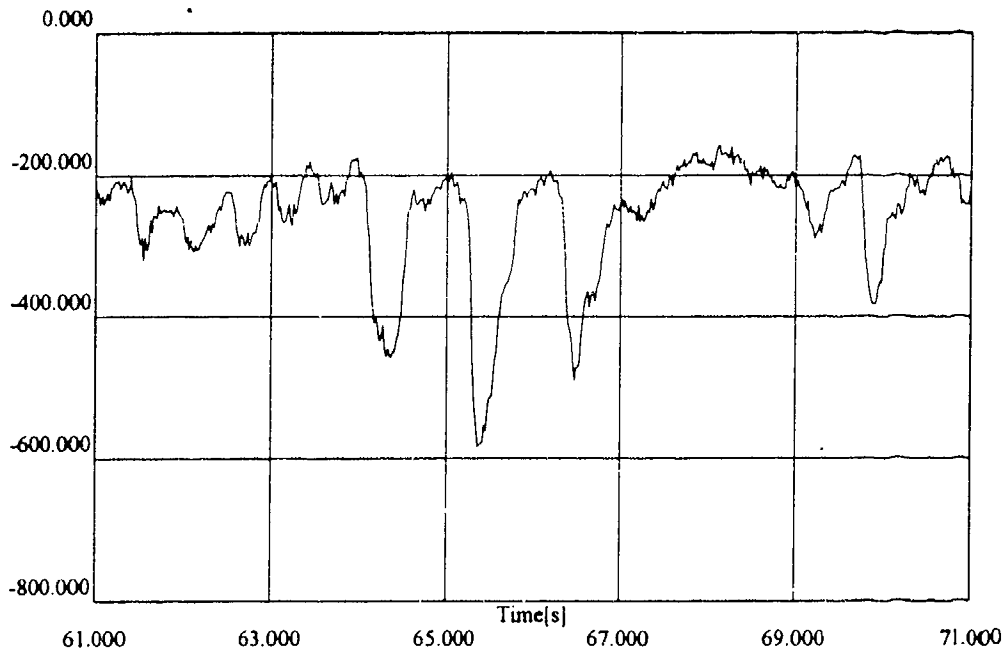

Figure 4: Left Hand Tensioner Displacement - Random Course at 17 kph (Fixed Tensioners)

Appendix 1 - Software Changes Prior to the Tank Trials

C25 Commands

The software has been made more efficient in several areas through the use of TMS320C25 commands. These require an updated assembler which was supplied (for use on PC) to DRA.

Energy Saving Subroutine

The efficiency of the valve linearising functions was improved and sources of potential software overflow removed.

Generalised Modal Displacements

The calculations of Hxs, Pxs, Rxs and Wxs were rewritten in a more efficient manner.

Variable Pitch and Heave Damping

This routine was rewritten for greater clarity. The code strategy remained the same.

Scaling of XTenL, XTenR, X5 and X6

The associated algorithms are now written in a manner that leaves the ADC values intact (for easier system diagnostics).

Auto Bias Tracking of Tensioners

Tensioner displacement error is integrated at a rate determined by the parameter Tbias, to produce the valve bias for each tensioner. This code is disabled by setting Tbias to zero.

Sign of GTen

The overall tensioner gain, GTen, in earlier software required a negative value. This has been made positive to be in line with active suspension software. GTen was also made specific to each tensioner, i.e. GTenL and GTenR.

TenOff replaced by XreqTL and XreqTR

It was found useful to be able to manually control the tensioner displacements individually rather than with one parameter for both tensioners.

PTenL Moved in ADC Frame

An intermittent spike seen in the left hand tensioner pressure signal was thought to be due to a hardware fault causing a voltage spike occasionally in ADC channel 1 only. PTenL was redirected to a spare ADC address.

Tensioner Biases as Parameters

In order to store and recall tensioner bias values (especially important if automatic tracking of tensioner biases is not being used).

CodeP1 Bit 11 Enabling Fixed GnB Gain of 8192

The Moog bypass valves fitted to the tank suspension have a more linear flow/pressure characteristic than the original TRW valves and a fixed gain was thought to be more appropriate than factoring by the GnB curve.

CodeP1 Bit 12 Enabling Tensioner Differential Pressure Software

It was known that there were problems in operating the tensioner lockout routine. This CodeP1 designation allowed the routine to be bypassed.

Appendix 2 - Software Changes as a Result of the Tank Trials

Differential Pressure Calculations

The tensioner stall code now takes valve bias into account and so gives a more accurate indication of required actuator velocity. This code was not implemented during the trials.

CodeP1 and TestP1

CodeP1 and TestP1 allocations have been made standard with other active vehicles.

Default Parameters

Default parameters were updated to 10-6.PAR with a change to the value of CodeP1 to reflect point 2 above.

Label File Information

Transducer scalings and units were added to the ADC frame. These produce scaling and unit information within the label file upon code assembly. Transducers can then be monitored in engineering units via DVI (Driver Vehicle Interface program) on the PC.

Routine Re-Ordering

Some of the software routines have been re-ordered to be more logical.

Bypass Valve Drive Limit

An unnecessary limit check on bypass valve drive was removed.

Appendix 3 - Software Changes as a Result of Writing the Strategy Book

Output Velocity Ratios

An error was found in the designation of output velocity ratios in the calculation of actual modal displacements (Hx, Px, Rx and Wx). The pitch velocity ratios were used in place of the heave values (and visa versa) and the roll and warp ratios were mismatched. This had no effect during the trials as the output velocity ratios all have the value 16384.

Torsion Bar Parallel Spring Terms

The proportion of force, attributable to the central wheel stations, accounted for at the end wheel station load cells has been found to be incorrect. The error is shown below for the left hand front. The pattern of error, however, is the same for all four corners.

Original Software :

F1sp = [Kbar1*X1*2 + KbarCl(XC2 + XC3*2 + XC4*3)]/65536

Corrected Software :

F1sp = [Kbar1*X1*2 + KbarCl(XC2*3 + XC3*2 + XC4)]/65536

Right Hand Track Tensioner Demanded Position

An error existed in the right hand track perimeter calculation. The algorithm in one place, when required to use the right hand rear displacement (X4), actually used X3. This is not thought to have had a major effect over the courses at Barnsfield Heath, Hurn. Over the random course and the sine waves the inputs to the vehicle are generally symmetrical left to right leading to similar actuator displacements X3 and X4.

Bypass Bias Evaluation Routine

The bypass bias routine has had some small errors removed which came about when the sign of bypass valve drive was switched (to be consistent with other active suspension vehicles) to be positive counts for a more closed position. This occurred during the hydraulic reworking that took place in the summer of 1993. This has had no effect on the running of the vehicle as bypass bias values have been determined manually in all cases since the modification.

Appendix 4 - Parameter Sets

File: 2-1.PAR
Comment: 1st set 2/11/93
Date: 2 Nov 93 13:37:45

VALF	0
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2176
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	25
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175

TbiasRm	0
KTen	5000
XreqTL	-325
XreqTR	-370
GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	0
Preq	-3000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	5000
HfMn	10000
IHCcMn	3000
PfMx	5000
PfMn	10000
IPCcMn	3000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2

MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000
Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	0
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 3-1.PAR
Comment: 3/11/93
Date: 3 Nov 93   12:26:08

VALF	0
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2176
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	25
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-475
XreqTR	-520

GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
HHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-1000
Preq	-2000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	5000
HfMn	10000
IHCcMn	[illegible] 00
PfMx	5000
PfMn	10000
IPCcMn	3000
KModel	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000
Gdr	15000

Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	0
Bdrywf	10000
Bdrycr	13000
Bdryer	13000

File: 4-1.PAR
Comment: New H/Preq & Xreqtl/r
Date: 4 Nov 93   12:15:07

VALF	0
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2176
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuWy	2048
KuWyf	0
KuWyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	25
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-515
XreqTR	-570

GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	5000
HfMn	10000
IHCcMn	3000
PfMx	5000
PfMn	10000
IPCcMn	3000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000
Gdr	15000

Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	0
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 4-2.PAR
Comment: Bdrycf,var. damping & PV on LHR
Date: 4 Nov 93 14:18:45

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	11
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	25
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-515

XreqTR	-570
GTenL	10000
GTenR	14000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	5000
HfMn	10000
IHCcMn	10000
PfMx	6000
PfMn	10000
IPCcMn	2000
KModel	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000

Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	5000
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 5-1.PAR
Comment: ES on LHR, var.
damping corrected
Date: 5 Nov 93 9:13:07

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuWy	2048
KuWyf	0
KuWyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-525

XreqTR	-610
GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	5000
IHCcMn	10000
PfMx	10000
PfMn	6000
IPCcMn	2000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000

Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	5000
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 5-2.PAR
Comment: Data run params
5/11/93
Date: 5 Nov 93 11:18:31

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuWy	2048
KuWyf	0
KuWyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-525
XreqTR	-610
GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	6000
IHCcMn	10000
PfMx	10000
PfMn	6000
IPCcMn	2000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000
Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	5000
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 9-1.PAR
Comment: Tensioner set-up
9/11/93
Date: 9 Nov 93 8:19:48

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Bawd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-545

XreqTR	-640
GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	6000
IHCcMn	10000
PfMx	10000
PfMn	6000
IPCcMn	2000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000

Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	5000
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 9-2.PAR
Comment: Data run params
9/11/93 Var.Damp.off
Date: 9 Nov 93 9:30:25

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-525
XreqTR	-620
GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16364
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	32767
IHCcMn	10000
PfMx	10000
PfMn	32767
IPCcMn	2000
KModel	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000
Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	0
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 9-3.PAR
Comment: Data run params
9/11/93 Var.Damp.on
Date: 9 Nov 93 10:23:54

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-525
XreqTR	-630
GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	6000
IHCcMn	10000
PfMx	10000
PfMn	6000
IPCcMn	2000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Inc	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000
Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	5000
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 9-4.PAR
Comment: Locked ten. fixed damping
Date: 9 Nov 93 13:43:13

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-605

XreqTR	-620
GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	32767
IHCcMn	10000
PfMx	10000
PfMn	32767
IPCcMn	2000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hnftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000

Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	0
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 10-1.PAR
Comment:10/11/93 - Run 1
Date: 10 Nov 93 9:50:21

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
Fscale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-595
XreqTR	-630

GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bbend	20
HfMx	10000
HfMn	6000
IHCcMn	10000
PfMx	10000
PfMn	6000
IPCcMn	2000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	157
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000
Gdr	15000

Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	5000
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 10-2.PAR
Comment: 10/11/93 - Lower tension (-190)
Date: 10 Nov 93 10:03:00

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KwVth	0
KwVf	0
KwVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-505

XreqTR	-570
GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	6000
IHCcMn	10000
PfMx	10000
PfMn	6000
IPCcMn	2000
KModel	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000

Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	5000
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 10-3.PAR
Comment: Bdrycf = 0, Hreq = -1500
Date: 10 Nov 93 10:04:11

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-505

XreqTR	-570
GTenL	10000
GTenR	10000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-1500
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	6000
IHCcMn	10000
PfMx	10000
PfMn	6000
IPCcMn	2000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000

Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	0
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 10-4.PAR
Comment: Hreq=-2000, GTenL/R = 15000
Date: 10 Nov 93 10:13:12

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-505

XreqTR	-570
GTenL	15000
GTenR	15000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	6000
IHCcMn	10000
PfMx	10000
PfMn	6000
IPCcMn	2000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000

Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	0
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 10-5.PAR
Comment: Pfmn = 5000
Date: 10 Nov 93 10:39:29

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-505
XreqTR	-570

GTenL	15000
GTenR	15000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bbend	20
HfMx	10000
HfMn	6000
IHCcMn	10000
PfMx	10000
PfMn	5000
IPCcMn	2000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000
Gdr	15000

Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	0
Bdryef	10000
Bdrycr	13000
Bdryer	13000

File: 10-6.PAR
Comment: IPCcMn 1000, PfMx
9000 DRA data set
Date: 10 Nov 93 11:23:02

VALF	1000
Kbar1	6000
Kbar2	6000
Kbar3	6000
Kbar4	6000
KbarCl	6500
KbarCr	6500
XCpre4l	-1000
XCpre4r	-1000
XScale	13500
XScaleT	20832
TenPar1	10650
TenPar2	5717
TenPar3	8700
SfF	12000
SfC	6000
Sfoff	-67
StTor	-225
KTor1	0
KTor2	0
KTor3	0
KTor4	0
Blim	200
FScale	18459
PScale	12124
CodeP1	2688
Wmax	32000
KwV	0
WCny	-2000
KuVth	0
KuVf	0
KuVr	0
Kufmx	15000
Kurmx	15000
KuNy	2048
KuNyf	0
KuNyr	0
Vlim	200
ThF	40
Bclose	0
BcloseS	2000
ESFLAG	15
IActAf	24395
IActAr	24395
AB1	200
AB2	-105
AB3	21839
DifBpMx	260
Dpvmin	1000
Dpvmax	1000
GnBmin	4000
Ck0	11583
Ck1	11583
Ck2	-11584
Ck3	11576
GfB1	9000
GfB2	9000
GfB3	9000
GfB4	9000
B1biasm	25
B2biasm	50
B3biasm	50
B4biasm	-25
Bback	-50
Badd	-10
Tbias	0
TbiasLm	175
TbiasRm	0
KTen	5000
XreqTL	-525

XreqTR	-560
GTenL	15000
GTenR	15000
IVrfH	16384
IVrrH	16384
IVrfP	18579
IVrrP	14189
IVrfR	16384
IVrrR	16384
IVrfW	18579
IVrrW	14189
MHKc	-12000
IHCc	20000
MPKc	-6000
IPCc	5000
MRKc	-5000
IRCc	20000
MWKc	-1000
IWCc	30000
MMf	0
MMr	0
Kwl1	0
Kbias	2
KbiasS	10
IVrfHO	16384
IVrrHO	16384
IVrfPO	16384
IVrrPO	16384
IVrfRO	16384
IVrrRO	16384
IVrfWO	16384
IVrrWO	16384
Hreq	-2000
Preq	-1000
Rbiasm	0
IPKt	0
IRKt	0
IWKt	0
HCnx+	0
HCnx-	0
HCny	0
PCnx+	-30000
PCnx-	-22000
PCny	-1500
RCnx+	0
RCnx-	0
RCny	-17000
RCyRat	16384
WCnx+	0
WCnx-	0
Bband	20
HfMx	10000
HfMn	6000
IHCcMn	10000
PfMx	9000
PfMn	5000
IPCcMn	1000
KModal	32000
KV1	1994
KV2	750
KV3	225
Kdynf	8000
Kdynr	8000
Kuff	0
Kurf	0
MMfc	0
MMrc	0
Hpftc	2
MKv	-6000
Ing	155
Gf1	25000
Gf2	25000
Gf3	25000
Gf4	25000
Gdf	15000

Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	22000
OPFcr	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimcr	16384
Xlimer	7840
Bdrycf	0
Bdryef	10000
Bdrycr	13000
Bdryer	13000